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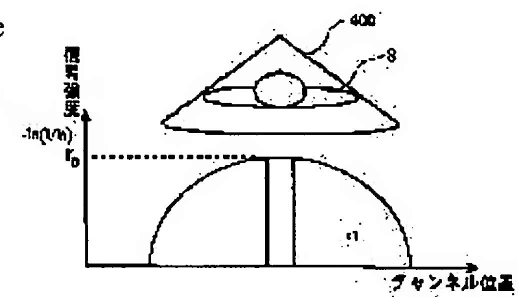
(54) TUBE CURRENT ADJUSTING METHOD AND DEVICE AND X-RAY CT DEVICE

(57)Abstract:
PROBLEM TO BE SOLVED: To reduce an X-ray exposure amount by determining an area of a projection obtained by the radioscopy of an object to be picked up by the X-ray in one of the major and minor axial directions, and a length of a diameter in the radioscopic direction, determining the length of a diameter vertical to this diameter by the calculation on the basis of the obtained diameter and the area of the projection, and adjusting the tube current of an X-ray tube on the basis of the obtained ratio of the major diameter and the minor diameter.



SOLUTION: An area s1 of a projection is determined on the basis of the total sum of projection data of each channel inputted from a data collection buffer, a length r0 of, for example, a minor diameter as a first diameter is determined by extracting the projection data on a projection central part, then the length of a second diameter vertical to the first diameter is determined on the basis of the area s1 and the first diameter assuming that a cross section of an object to be picked up is an oval, a tube current is calculated on the basis of the area s1, an oval ratio is determined on the basis of the first and second diameters, and the tube current is corrected corresponding to the oval ratio. The radioscopic photography only in one direction is enough which reduces the exposure amount in half.

LEGAL STATUS

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1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the block diagram of the equipment of an example of the gestalt of operation of this invention.
[Drawing 2] It is the ** type view of the detector array in the equipment shown in drawing 1 .
[Drawing 3] It is the ** type view of the X-ray irradiation and detection equipment in the equipment shown in drawing 1 .
[Drawing 4] It is the ** type view of the X-ray irradiation and detection equipment in the equipment shown in drawing 1 .
[Drawing 5] It is the block diagram of the central processing unit about a tube electric current regulation function.
[Drawing 6] It is the conceptual diagram of the projection for an image pck-up.
[Drawing 7] It is the graph which shows the relation between projection area and SD.
[Drawing 8] It is the graph which shows the relation between an oval ratio and a tube electric current correction factor.
[Drawing 9] It is the flow view of operation of the equipment shown in drawing 1 .
[Drawing 10] It is the flow view of operation of the equipment shown in drawing 1 .
[Description of Notations]
2 Scanning Gantry
4 Image Pck-up Table
6 Operation Console
8 Candidate for Image Pck-up
20 X-ray Tube
22 Collimator
24 Detector Array
26 Data Collection Section
28 X-ray Controller
30 Collimator Controller
34 Rotation Section
36 Rotation Controller
60 Central Processing Unit
62 Control Interface
64 Data Collection Buffer
66 Storage
68 Display
70 Operating Set
602 Projection Area Calculation Unit
604 1st Path Decision Unit
606 2nd Path Calculation Unit
608 Tube Electric Current Calculation Unit
610 Oval Ratio Calculation Unit
612 Tube Electric Current Amendment Unit

[Translation done.]

* NOTICES *

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] Especially this invention relates to the X-ray CT scanner equipped with the tube electric current regulation method, the equipment, and such a tube electric current adjustment for optimizing the tube electric current of an X-ray tube about the tube electric current regulation method, equipment, and X-ray CT (computerized tomography) equipment.
[0002]
[Description of the Prior Art] In an X-ray CT scanner, the X-ray irradiation equipment containing an X-ray tube irradiates the X-ray beam (beam) which has thickness in the direction perpendicular to it with the breadth (width of face) which includes the photography range. The thickness of an X-ray beam can be changed now by adjusting the opening of X-ray passage opening (aperture : aperture) of a collimator (collimator), and slice (slice) ** of photography is adjusted by this.
[0003] X-ray detection equipment has the X-ray detector of many channels (channel) which arranged the X-ray sensing element [a large number (for example, about 1000 pieces)] in the shape of an array (array) in the width-of-face direction of an X-ray beam, and detects an X-ray by it.
[0004] X-ray irradiation and detection equipment are rotated by the surroundings for photography (scan : scan), it asks for the projection image for [by the X-ray] photography (projection : projection), respectively in two or more directions of a view (view) of the circumference for photography, and a computer (computer) generates a tomogram based on these projection data (projection data) (reconstruction).
[0005] Standard deviation (SD:Standard Deviation) is used as one of the indexes showing the quality of a reconstruction picture. Since SD has the area of the projection for an image pck-up, and strong correlation when the tube electric current of an X-ray tube is set constant, in order to obtain the tomogram for proper SD, regulating the tube electric current automatically according to the area of a projection is performed.
[0006] In automatic regulation of the tube electric current, the candidate for an image pck-up is beforehand seen through through an X-ray, and it asks for a projection, and asks for the proper tube electric current according to the area. the tube electric current for which it asked the account of a top according to the ratio of an oval ratio (oval ratio), i.e., a major axis, and a minor axis since cross sections, such as a human body used as the candidate for an image pck-up, are ellipse forms in general and the major-axis direction differed in the amount of transparency of an X-ray from the direction of a minor axis at that time -- an amendment -- it is made like
[0007] In order to find the length of a major axis and a minor axis, the candidate for an image pck-up is seen through through an X-ray, respectively from a transverse plane (the direction of 0 degree), and the side (the direction of 90 degree), and the value of the center section of the projection of the direction of 0 degree is made into the length of a minor axis, and let the value of the center section of the projection of the direction of 90 degree be the length of a major axis.
[0008]

[Problem(s) to be Solved by the Invention] In the above-mentioned tube electric current regulation, since the candidate for an image pck-up had to be seen through through the X-ray the direction of 0 degree, and from 90 degree, respectively, there was a problem of being inefficient. Moreover, since it had to see through twice, there was a problem that the amount of contamination of the X-ray for an image pck-up increased.
[0009] Made in order that this invention might solve the above-mentioned trouble, the purpose is realizing the efficient tube electric current regulation method and efficient equipment, and the X-ray CT scanner equipped with such a tube electric current adjustment. Moreover, it aims at realizing the X-ray CT scanner equipped with the tube electric current regulation method and equipment with few amounts of contamination, and such a tube electric current adjustment of an X-ray for an image pck-up.
[0010]
[Means for Solving the Problem] (1) Invention in the 1st viewpoint for solving the above-mentioned technical problem It is the tube electric current regulation method of adjusting the tube electric current of an X-ray tube based on the ratio of the major axis when assuming the area of the projection for [by the transparency X-ray] an image pck-up, and the cross section for [aforementioned] an image pck-up to be ellipses, and a minor axis. It asks for the area of the projection which saw through the aforementioned candidate for an image pck-up through the X-ray in the direction of either the aforementioned major axis or a minor axis. It is the tube electric current regulation method characterized by calculating using the length of the path for which it asked the account of before with the area of the projection which found the length of a path perpendicular to the path which defined the length of the path of the direction which carried out [aforementioned] fluoroscopy based on the value of the center section of the aforementioned projection, and was defined the account of before the account of before.
[0011] (2) Invention in the 2nd viewpoint for solving the above-mentioned technical problem It is the tube electric current adjustment which adjusts the tube electric current of an X-ray tube based on the ratio of the major axis when assuming the area of the projection for [by the transparency X-ray] an image pck-up, and the cross section for [aforementioned] an image pck-up to be ellipses, and a minor axis. An area calculation means to ask for the area of the projection which saw through the aforementioned candidate for an image pck-up through the X-ray in the direction of either the aforementioned major axis or a minor axis, A path decision means to define the length of the path of the direction which carried out [aforementioned] fluoroscopy based on the value of the center section of the aforementioned projection, It is the tube electric current adjustment characterized by providing a path calculation means to calculate using the length of the path for which it asked the account of before with the area of the projection which found the length of a path perpendicular to the path defined the account of before the account of before.
[0012] (3) Invention in the 3rd viewpoint for solving the above-mentioned technical problem The X-ray irradiation means containing an X-ray tube, and a tube electric current regulation means to adjust the tube electric current of the aforementioned X-ray tube, It is the X-ray CT scanner which has an X-ray detection means and a tomogram generation means to generate a tomogram based on the X-ray detecting signal of two or more views detected with the aforementioned X-ray detection means, and is the X-ray CT scanner characterized by using the tube electric current adjustment of a publication for (2) as the aforementioned tube electric current regulation means.
[0013] (4) In case invention in other viewpoints for solving the above-mentioned technical problem adjusts the tube electric current of an X-ray tube, irradiates an X-ray from the aforementioned X-ray tube, detects the aforementioned X-ray and generates a tomogram based on the X-ray detecting signal of two or more views which carried out [aforementioned] detection, it is the X-ray fault image pck-up method characterized by using the method of a publication for (1) adjusting the aforementioned tube electric current.
[0014] (Operation) In this invention, the length of the path of a direction which saw through the candidate for an image pck-up through the X-ray in the direction of either a major axis or a minor axis, and asked for and saw through the projection is defined based on the value of the center section of the projection, and the length of a path perpendicular to it is calculated using the area of a projection, and

the length of the path of the seen-through direction. Thereby, on the other hand, transillumination is sufficient from Mukai.

[0015]

[Embodiments of the Invention] Hereafter, with reference to a drawing, the gestalt of operation of this invention is explained in detail. In addition, this invention is not limited to the gestalt of operation. The block (block) view of an X-ray CT scanner is shown in drawing 1 . This equipment is an example of the gestalt of operation of this invention. An example of the gestalt of the operation about the equipment of this invention is shown by the composition of this equipment. An example of the gestalt of the operation about the method of this invention is shown by operation of this equipment.

[0016] This equipment is equipped with the scanning gantry (gantry) 2, the image pck-up table (table) 4, and the operation console (console) 6 as shown in drawing 1 . The scanning gantry 2 has X-ray tube 20. The X-ray which was emitted from X-ray tube 20 and which is not illustrated is fabricated so that it may become the X-ray beam (fan beam) of a flabellate, i.e., a fan beam, with a collimator 22, and it is irradiated by the detector array 24. The detector array 24 has two or more X-ray sensing elements arranged in the shape of an array in the width-of-face direction of the X-ray beam of a flabellate. The composition of the detector array 24 is explained anew later.

[0017] X-ray tube 20 and a collimator 22 are examples of the gestalt of operation of the X-ray irradiation means in this invention. The detector array 24 is an example of the gestalt of operation of the X-ray detection means in this invention. X-ray tube 20, a collimator 22, and the detector array 24 constitute X-ray irradiation and detection equipment. X-ray irradiation and detection equipment are explained anew later. The data collection section 26 is connected to the detector array 24. The data collection section 26 collects the detection data of each X-ray sensing element of the detector array 24.

[0018] Irradiation of the X-ray from X-ray tube 20 is controlled by the X-ray controller (controller) 28. In addition, illustration is omitted about the connection relation between X-ray tube 20 and the X-ray controller 28. A collimator 22 is controlled by the collimator controller 30. In addition, illustration is omitted about the connection relation between a collimator 22 and the collimator controller 30.

[0019] The thing from above X-ray tube 20 to the collimator controller 30 is carried in the rotation section 34 of the scanning gantry 2. Rotation of the rotation section 34 is controlled by the rotation controller 36. In addition, illustration is omitted about the connection relation between the rotation section 34 and the rotation controller 36.

[0020] The image pck-up table 4 carries in and takes out the candidate for an image pck-up which is not illustrated to the X-ray irradiation space of the scanning gantry 2. A relation with the X-ray irradiation space for an image pck-up is explained anew later.

[0021] The operation console 6 has the central processing unit 60. A central processing unit 60 is constituted by the computer (computer) etc. The control interface (interface) 62 is connected to the central processing unit 60. The scanning gantry 2 and the image pck-up table 4 are connected to the control interface 62. A central processing unit 60 controls the scanning gantry 2 and the image pck-up table 4 through a control interface 62.

[0022] The data collection section 26, the X-ray controller 28, the collimator controller 30, and the rotation controller 36 in the scanning gantry 2 are controlled through a control interface 62. In addition, illustration is omitted about the individual connection between these each part and a control interface 62.

[0023] The portion which consists of a central processing unit 60, a control interface 62, and an X-ray controller 28 is an example of the gestalt of operation of the tube electric current adjustment of this invention. An example of the gestalt of the operation about the equipment of this invention is shown by the composition of this equipment. An example of the gestalt of the operation about the method of this invention is shown by operation of this equipment. The portion which consists of a central processing unit 60, a control interface 62, and an X-ray controller 28 is an example of the gestalt of operation of the tube electric current regulation means in this invention again.

[0024] The data collection buffer 64 is connected to the central processing unit 60. The data collection section 26 of the scanning gantry 2 is connected to the data collection buffer 64. The data collected in

the data collection section 26 are inputted into the data collection buffer 64. The data collection buffer 64 memorizes input data temporarily.

[0025] A central processing unit 60 performs picture reconstruction based on the projection of two or more views collected through the data collection buffer 64. A central processing unit 60 is an example of the gestalt of operation of the tomogram generation means in this invention. For example, the fill TADO back projection (filtered back projection) method etc. is used for picture reconstruction. Storage 66 is connected to the central processing unit 60. Storage 66 memorizes data, various kinds of reconstruction pictures, programs (program), etc.

[0026] Display 68 and the operating set 70 are connected to the central processing unit 60, respectively. Display 68 displays the reconstruction picture outputted from a central processing unit 60, and the information on other. An operating set 70 is operated by the operator and inputs various kinds of directions, information, etc. into a central processing unit 60.

[0027] The typical composition of the detector array 24 is shown in drawing 2 . The detector array 24 serves as an X-ray detector of many channels which arranged many X-ray sensing elements 24 (i). Many X-ray sensing elements 24 (i) form the X-ray plane of incidence which curved in the shape of a cylinder concave surface as a whole. i is a channel number, for example, is i=1-1000.

[0028] The X-ray sensing element 24 (i) is constituted by the combination of a scintillator (scintillator) and a photodiode (photo diode). In addition, you may be not the thing to restrict to this but an ionization chamber type X-ray sensing element using for example, the semiconductor X-ray sensing element using the cadmium tellurium (CdTe) etc. or xenon (Xe) gas.

[0029] The interrelation of X-ray tube 20 and collimator 22 in X-ray irradiation and detection equipment, and the detector array 24 is shown in drawing 3 . In addition, they are drawing showing the state where (a) of drawing 3 was seen from the transverse plane of the scanning gantry 2, and drawing showing the state where (b) was seen from the side. As shown in this drawing, the X-ray emitted from X-ray tube 20 is fabricated so that it may become X-ray beam 400 of a flabellate with a collimator 22, and is irradiated by the detector array 24.

[0030] (a) of drawing 3 shows the breadth of X-ray beam 400 of a flabellate, i.e., the width of face of X-ray beam 400. The cross direction of X-ray beam 400 is in agreement in the array direction of the channel in the detector array 24. (b) shows the thickness of X-ray beam 400.

[0031] As a body axis is made to intersect the fan of such X-ray beam 400, for example, it is shown in drawing 4 , the candidate 8 for an image pck-up laid in the image pck-up table 4 is carried in to X-ray irradiation space. The scanning gantry 2 has tubed structure which includes X-ray irradiation and detection equipment inside.

[0032] X-ray irradiation space is formed in the inside space of the tubed structure of the scanning gantry 2. The image for [which was sliced by X-ray beam 400 / 8] an image pck-up is projected on the detector array 24. The X-ray which penetrated the candidate 8 for an image pck-up is detected by the detector array 24. The thickness th of X-ray beam 400 which irradiates the candidate 8 for an image pck-up is set up by opening regulation of the aperture of a collimator 22.

[0033] The block diagram of the central processing unit 60 about tube electric current regulation is shown in drawing 5 . The function of each block in this drawing is realized by the computer program etc. As shown in this drawing, a central processing unit 60 has the projection area calculation unit (unit) 602. The projection area calculation unit 602 is an example of the gestalt of operation of the area calculation means in this invention. The projection area calculation unit 602 calculates the area about the projection which sees through the candidate 8 for an image pck-up through an X-ray, and is obtained.

[0034] Drawing 6 explains projection area calculation. As shown in this drawing, supposing it obtains the projection of for example, the direction of 0 degree by X-ray beam 400 about the candidate 8 for an image pck-up, the projection area calculation unit 602 will ask for total of the projection data of each channel inputted from the data collection buffer 64, and will make this the area s1 of a projection.

[0035] The 1st path decision unit 604 decides the length of a path parallel to the 1st the path of a projection, i.e., direction, of [when assuming the cross section for / 8 / an image pck-up to be an ellipse] based on the projection data inputted from the data collection buffer 64. The 1st path decision

unit 604 is an example of the gestalt of operation of the path decision means in this invention.
[0036] Since the length of a path parallel to the direction of a projection is expressed by the projection data in the height of the center section of the projection, i.e., the center section of the projection, it extracts the projection data based on the data measured, for example by the central channel of the detector array 24, and makes this the length r0 of the 1st path. Here, since it asks for the 1st path from the projection of the direction of 0 degree, it turns into a minor axis of an ellipse. In addition, it is desirable in asking for the 1st path to adopt the average of the projection data based on a central channel and two or more channels of the near at the point of acquiring a highly accurate value.
[0037] The 2nd path calculation unit 606 calculates the 2nd path when assuming that the cross section for [8] an image pck-up is an ellipse, i.e., a path perpendicular to the 1st path, (here major axis) using the 1st path inputted as the projection area inputted from the projection area calculation unit 602 from the 1st path decision unit 604. The 2nd path calculation unit 606 is an example of the gestalt of of the path calculation means in this invention.
[0038] Calculation of the 2nd path is performed based on the formula of the area of an ellipse. Since the area of an ellipse becomes settled by the product of a major axis, a minor axis, and a circular constant, among these understands area s1 and the minor axis r0, it can ask for a major axis r90 by calculation.
[0039] The tube electric current calculation unit 608 calculates the tube electric current based on the projection area s1 inputted from the projection area calculation unit 602. SD corresponding to the projection area s1 is first calculated in calculating the tube electric current. The correspondence relation as beforehand asked for the relation of the projection area S and SD by phantom (phantom) measurement under the standard tube electric current etc., for example, shown in drawing 7 is memorized by memory.
[0040] Then, it asks for SD delta a corresponding to the projection area s1 from such a relation. A relation like the following formula between the tube electric current mAa which gives this SDdeltaa, and the tube electric current mAb which gives SDdeltab required of a reconstruction picture is.
[0041]
[Equation 1]

$$\frac{\sigma_b}{\sigma_a} = \sqrt{\frac{mAa}{mAb}} \qquad (1)$$

[0042] From this relation [to 0043 [then,]]
[Equation 2]

$$mAb = \left(\frac{\sigma_a}{\sigma_b}\right)^2 \cdot mAa \qquad (2)$$

[0044] It is alike and, therefore, asks for the desired tube electric current. The 2nd path r90 which the 1st inputted from the 1st path decision unit 604 reached path r0, and was inputted from the 2nd path calculation unit 606 is used for the oval ratio calculation unit 610, and it is an oval ratio [0045].
[Equation 3]

$$R = \frac{r_{90}}{r_0} \qquad (3)$$

[0046] ********. The tube electric current amendment unit 612 amends the tube electric current mAb inputted from the tube electric current calculation unit 608 according to the oval ratio R inputted from the oval ratio calculation unit 610. The relation between the oval ratio R and a correction factor K is beforehand given, as shown in drawing 8 , and it amends the tube electric current like the following formula using the correction factor K which can be found from this relation.
[0047]
[Equation 4]

$$mA b' = K \cdot mAb \qquad (4)$$

[0048] The signal showing tube electric current mAb' after amendment is given to the X-ray controller 28 through a control interface 62. Operation of this equipment is explained. It is in charge of operation of this equipment, and tube electric current regulation according to the candidate for an image pck-up is performed first. The flow (flow) view of a tube electric current control action is shown in drawing 9 . Hereafter, this drawing explains tube electric current regulation.
[0049] First, scout (scout) photography is performed at Step (step) 902. Scout photography performs transillumination photography from a predetermined direction about the part which is going to picturize a tomogram from this for [8] an image pck-up. Suppose that the direction of scout photography is the transverse plane the direction 8 of 0 degree, i.e., for an image pck-up. In addition, you may be made to carry out instead of considering as the direction of 0 degree from the side the direction 8 of 90 degree, i.e., for an image pck-up. Hereafter, also in the direction of 90 degree, it becomes the same although the example of the direction of 0 degree explains.
[0050] Next, the projection area s1 is calculated at Step 904. Calculation of the projection area s1 is performed as mentioned above by the projection area calculation unit 602.
[0051] Next, the 1st path is decided at Step 906. Decision of the 1st path is made as mentioned above by the 1st path decision unit 604. Next, the 2nd path is calculated at Step 908. Calculation of the 2nd path is performed as mentioned above by the 2nd path calculation unit 606.
[0052] Next, the tube electric current is calculated at Step 910. Calculation of the tube electric current is performed as mentioned above by the tube electric current calculation unit 608, the oval ratio calculation unit 610, and the tube electric current amendment unit 612.
[0053] Thus, the tube electric current [finishing / amendment] by the oval ratio can be obtained only by on the other hand performing transillumination photography from Mukai. Therefore, the efficiency of tube electric current regulation can be raised, and the amount of contamination for [8] an image pck-up can be reduced in the conventional half.
[0054] The flow view of operation at the time of the image pck-up of this equipment is shown in drawing 10 . As shown in this drawing, an operator inputs a scanning plan through an operating set 70 at Step 912. X-ray irradiation conditions, slice thickness, a slice position, etc. are included in a scanning plan. Here, the tube electric current is regulated automatically as mentioned above among X-ray irradiation conditions. Hereafter, this equipment operates under operation of an operator and control by the central processing unit 60 according to the inputted scanning plan.
[0055] Scanning positioning is performed at Step 914. That is, an operator operates an operating set 70, moves the image pck-up table 4, and makes it in agreement with the center (isocenter : isocenter) of rotation of the center of the image pck-up part for [8] an image pck-up of X-ray irradiation and detection equipment.
[0056] After performing such scanning positioning, a scan is performed at Step 916. That is, X-ray irradiation and detection equipment are rotated in the circumference for [8] an image pck-up, for example, the projections of 1000 views are collected to the data collection buffer 64.
[0057] After a scan or in parallel to a scan, picture reconstruction is performed at Step 918. That is, based on the projection of two or more views collected to the data collection buffer 64, for example, by the fill TADO back projection method etc., a central processing unit 60 performs picture reconstruction, and generates a tomogram.
[0058] The reconfigurated tomogram is expressed to display 68 as Step 920. Since the tube electric current is regulated automatically according to the projection area and the oval ratio for an image pck-up, a quality tomogram can be obtained.
[0059]
[Effect of the Invention] As explained to the detail above, according to this invention, the efficient tube electric current regulation method and efficient equipment, and the X-ray CT scanner equipped with such a tube electric current adjustment are realizable. Moreover, the X-ray CT scanner equipped with the tube electric current regulation method and equipment with few amounts of contamination, and such a tube electric current adjustment of an X-ray for an image pck-up is realizable.

[Translation done.]

* NOTICES *

CLAIMS

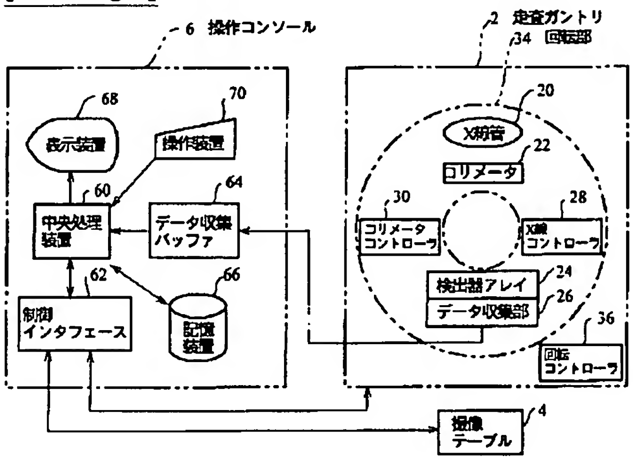
[Claim(s)]
[Claim 1] It is the tube electric current regulation method of adjusting the tube electric current of an X-ray tube based on the ratio of the major axis when assuming the area of the projection for [by the transparency X-ray] an image pck-up, and the cross section for [aforementioned] an image pck-up to be ellipses, and a minor axis. It asks for the area of the projection which saw through the aforementioned candidate for an image pck-up through the X-ray in the direction of either the aforementioned major axis or a minor axis. The tube electric current regulation method characterized by what the length of a path perpendicular to the path which defined the length of the path of the direction which carried out [aforementioned] transillumination based on the value of the center section of the aforementioned projection, and was defined the account of before is calculated for using the area of the projection for which it asked the account of before, and the length of the path for which it asked the account of before.
[Claim 2] The tube electric current adjustment which adjusts the tube electric current of an X-ray tube based on the ratio of the major axis when assuming the area of the projection for [by the transparency X-ray characterized by providing the following] an image pck-up, and the cross section for [aforementioned] an image pck-up to be ellipses, and a minor axis An area calculation means to ask for the area of the projection which saw through the aforementioned candidate for an image pck-up through the X-ray in the direction of either the aforementioned major axis or a minor axis A path calculation means to calculate the length of a path perpendicular to the path determined as a path decision means to define the length of the path of the direction which carried out [aforementioned] transillumination based on the value of the center section of the aforementioned projection, the account of before using the area of the projection for which it asked the account of before, and the length of the path for which it asked the account of before
[Claim 3] The X-ray CT scanner which is an X-ray CT scanner which has the X-ray irradiation means containing an X-ray tube, a tube electric current regulation means to adjust the tube electric current of the aforementioned X-ray tube, an X-ray detection means, and a tomogram generation means to generate a tomogram based on the X-ray detecting signal of two or more views detected with the aforementioned X-ray detection means, and is characterized by using a tube electric current adjustment according to claim 2 as the aforementioned tube electric current regulation means.

[Translation done.]

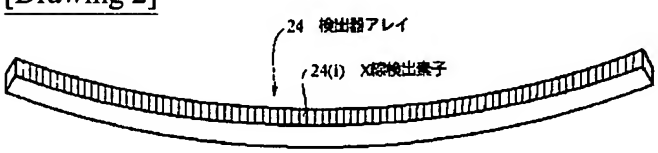
* NOTICES *

DRAWINGS

[Drawing 1]



[Drawing 2]



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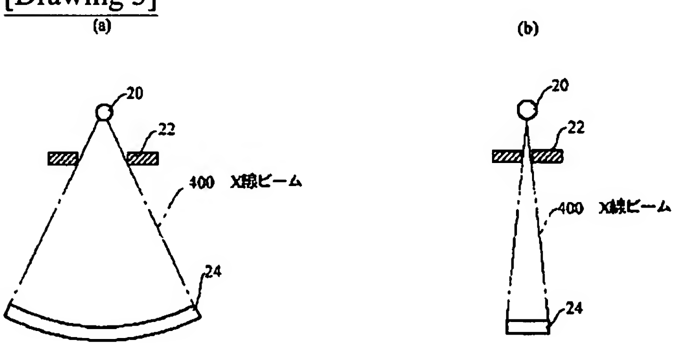

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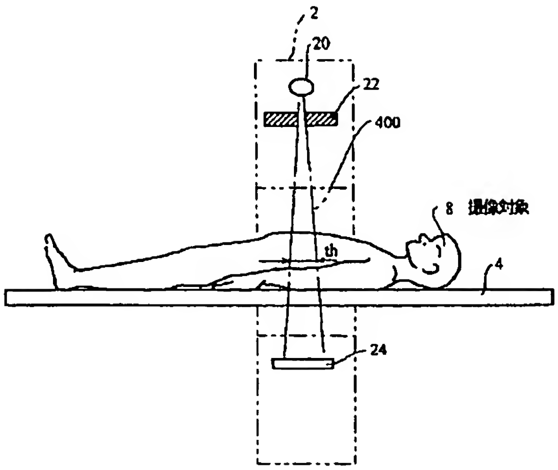
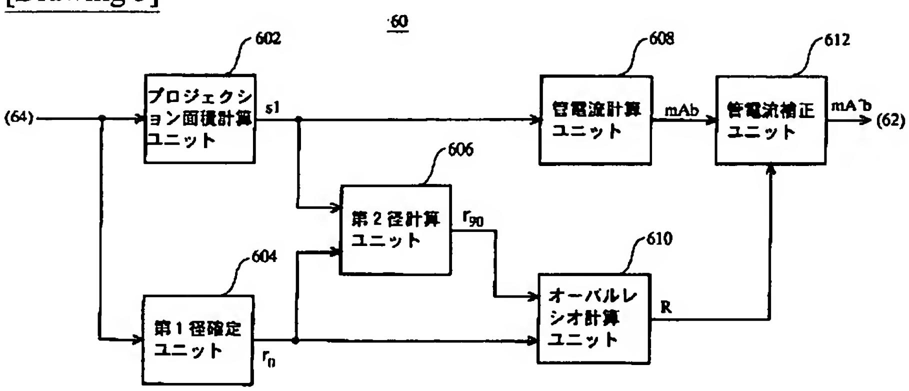


[Drawing 5]



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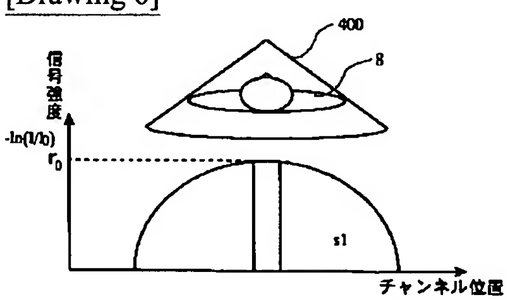
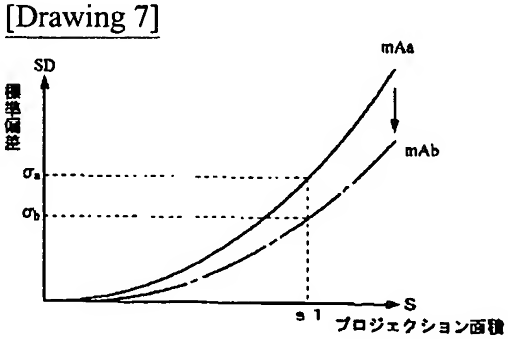
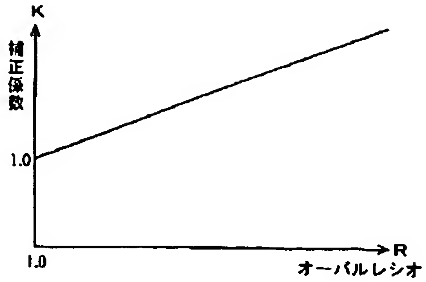


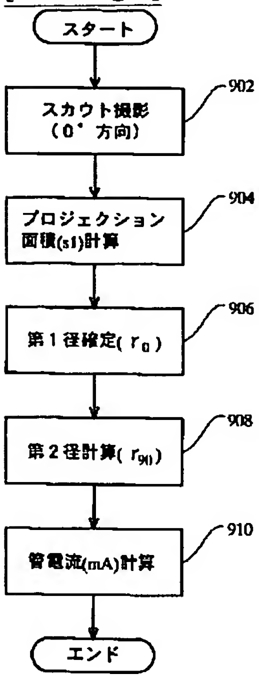
[Drawing 7]



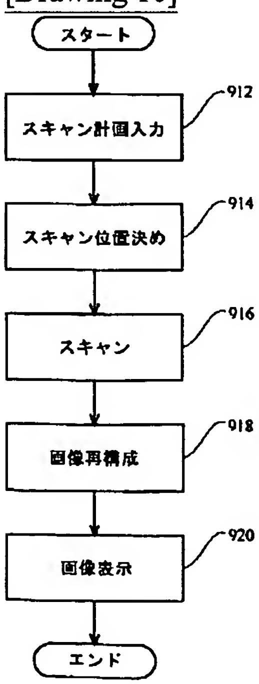
[Drawing 8]



[Drawing 9]



[Drawing 10]



[Translation done.]